

An Analysis of Development Countermeasures for Promoting Reform and Optimization of Transportation Structures Based on Highway-Railway Combined Transport in China

Fengwei Kang, Xuemei Li, Huizhuo Cao, Can Yang

Beijing Jiaotong University, Beijing, China

Keywords: Transportation structure, Highway-to-railway, Highway-railway combined transport

Abstract: As pollution due to the China's transportation environment, and the sharpening of the contradiction between the supply of transportation and the demand, it has become the top priority for current freight transportation to increase the proportion of railway transportation and optimize the existing structures. It is of great significance to advance the reform of "highway-to-railway" for freight transport to do well in the Blue Sky Protection Campaign and pollution prevention, improve comprehensive transport efficiency, reduce logistics costs, and promote economic and social development of China. This paper firstly reviews China's policy orientation in promoting the optimization of transportation structure, and then analyzes the advantages and development prospects of highway-railway combined transport. At last, it puts forward countermeasures and suggestions on how to better develop the combined transport in terms of increasing subsidies for highway-railway combined transport, regulating market order, formulating standardized rules, encouraging the reform of business entities, and building a full-process smart logistics service platform.

1. Introduction

With the rapid development of the economy in recent years, China's transportation industry has made great progress. As the basic, and leading industry of national economic development, the transportation industry is a powerful force of production and a guarantee for social and economic development. The rapid developments in construction of Chinese transportation infrastructure have not only improved the transportation capacity, but also greatly promoted the increase in freight turnover. Among the various modes of transportation, highway transportation has always been the main force in the transportation industry. From 2010 to 2019, China's total highway mileage and highway density showed a steady rising trend. At the end of 2019, the total national highway mileage was 5.0125 million kilometers, increased of 166,000 kilometers over 2018 and by approx. 2% on a year-on-year basis. The density of the highways was 52.21 kilometers per 100 square kilometers, increased of 1.73 kilometers per 100 square kilometers and by approx. 3% on a year-on-year basis. The growth rate has increased significantly from the previous year^[1]. In 2019, the road transportation accounted for the largest proportion (72.99%) of freight transportation volumes, followed by water transportation (15.87%). Railway transportation accounted for 9.18%, ranking the third, while civil aviation freight volume accounted for only 0.02%^[2].

With the continuous increase of vehicle parc, vehicle exhaust pollution control has become the top priority of air pollution control in China. In addition, the road freight industry has been overloaded for a long time accompanied by other abnormal freight chaos occurring frequently, thus it is urgent to accelerate the pace of the reform of Chinese freight transportation structure. The energy consumption per unit of freight turnover and the emission of major pollutants per unit of freight volume of railway freight transport are only 1/7 and 1/13 of those of highway freight transport respectively, as a result, there is broad space for development. At present, China is vigorously promoting the "highway-to-railway" and actively developing highway-railway combined transport. Under this new situation, it is necessary to analyze the necessity and broad prospects for the development of highway-railway combined transport, discuss its development

countermeasures, and actively promote the market's rapid and healthy development.

2. The Necessity Analysis and Prospects of Developing Highway-Railway Combined Transport in China

2.1 National Policy Guidance on Promoting the Reform of Transportation Structure

In 2018, General Secretary Jinping Xi repeatedly emphasized the need to vigorously promote the adjustment of transportation structure at the Central Economic Conference, the first meeting of the Central Finance and Economics Committee and the National Ecological and Environmental Protection Conference. In June, Premier Keqiang Li made arrangements to adjust the transportation structure at the executive meeting of the State Council. The idea of “highway-to-railway” was mentioned again at the national meeting. From the perspective of pollution control, the Ministry of Ecology and Environment helped deepen the implementation of “highway-to-railway”. At the end of June, the Ministry issued the *Three-Year Action Plan for the Blue Sky Protection Campaign*, expanding the areas and goods for executing “highway-to-railway”. The purpose of the plan is to increase 2017’s national railway freight volume by 30% by 2020. The Ministry of Transport advocates the development of multimodal combined transportation from the perspective of cost reduction and efficiency enhancement. The Ministry issued the *Three-Year Action Plan for Promoting Transport Structure Adjustment* and put forward six major motions aimed at increasing the proportion bulk cargo transported by railways and long-distance transportation, and strengthening highway freight management. From 2016 to 2018, the Ministry of Transport has announced three batches of multimodal combined transport demonstration projects, totaling 70 projects. So far, the policy of “highway-to-railway” has had clear direction from the central government and the ministries and commissions, and has put forward higher requirements in both depth and breadth. After more than two years of development, the proportion of highway freight volume has gradually decreased, while railway freight volume has gradually increased, however, the actual effect is still low as expected from the current situation. There is still a long way to go.

2.2 The Only Path to Build a Green Transportation System

Clean and efficient logistics in transportation are the developmental direction of modern logistics. Compared with highway transportation, railway transportation consumes lower energy while achieving the same volume of transportation. At the same time, it can also reduce the consumption of goods during transportation and achieve the purpose of reducing cargo damage and improving transportation efficiency. In terms of infrastructure construction, the land area occupied by railway per unit of transport volume is only 1/10 of that by highway. Thus, implementing the national transportation structure adjustment strategy, building a green transportation system, vigorously developing railway transportation capabilities, and promoting highway-railway combined transport are the top priorities.

2.3 Development Prospects of Highway-Railway Combined Transport

Highway-railway combined transport refers to the method in which carriage operators transport goods to the designated place of delivery through both highway and railway transportation, with the participation of multiple transportation entities^[3]. Take railway transportation as an example. In the medium and long-distance transportation, railway transportation with a large-scale operation mode and a containerized loading method has huge advantages compared with transportation by automobile. Especially for bulk cargo such as coal, which is in huge social demand, railway transportation is not only economical but also very environmentally friendly. However, within short-distance transportation markets, automobile transportation is much more flexible than railway. If the two modes of transportation can be matched with each other, it will not only effectively increase the cargo turnover rate, but also greatly reduce the transportation cost. This efficient way of combined transportation is “highway-railway combined transport”. Railway transportation can not only achieve near-zero pollution emissions, but also give full play to

backbone advantages in the field of medium and long-distance transportation. The innovative modes of “bulk-to-package” transportation also reduce the normal loss of goods in the transportation process and effectively improve the efficiency of intermodal transportation. Highways can give full play to the advantages of convenience and drayage, and become a connection with other modes of transportation. It can be seen that the railway-led highway-railway combined transport can make an important contribution for both *Blue Sky Protection Campaign* and building a moderately well-off society in an all-round way. It will become the main inland combined transport mode^[4]. At present, China's highway-railway combined transport has achieved certain development level, but there are still problems such as low standardization, imperfect informatization, and insufficient market subsidies that all need to be resolved. On the basis of the current level of highway-railway combined transport development, it is necessary to continuously improve cooperation between highway and railway transport modes.

3. Analysis of Development Countermeasures for Highway-Railway Combined Transport

3.1 Aiming At Key Links of Intermodal Transportation, Subsidies-Guided Standard Operation

At present, the National Development and Reform Commission's subsidies for highway-railway combined transport are concentrated on inland port companies and collection and distribution centers. There is a lack of control over the qualifications of enterprises, and their subsequent operations. The main problem with highway-railway combined transport is that the drayage cost at both ends is high, and the price advantage is not obvious, or that there may even be disadvantages. Therefore, the principle of government subsidies is to fully mobilize the enthusiasm of transportation companies to develop highway-railway combined transport. The basis of highway-railway combined transport is “transportation”, and the key and difficult part is “combination”. It requires railway transportation to be efficient, and a certain level of capacity and station transfer in order to show comparative advantages and combined efficiency of different transportation modes. Drawing on international experience, the German Ministry of Transport and Digital Infrastructure (BMVI) issued *Subsidy Guidelines* in early 2017, focusing on subsidies for special railway lines and private stations. The German Federal Railway Administration is responsible for granting subsidies to special railway lines, with the ratio of overall subsidies granted reaching 44.4%. The subsidy ratio for newly built and expanded private stations is up to 80%. The subsidies are only provided for hardware facilities, and the applicant enterprises must ensure continuous operation for 10 or 20 years. They should be connected to the public network and open to the society. The principle of German subsidies is to reduce enterprises' operating costs for the stations and improve the efficiency of transfers. The subsidies will not be used to compete for sources of goods, monopolize the market, and other behaviors that disrupt the order of the market.

Based on the above analysis, the government's cultivation of highway-railway combined transport can be achieved through subsidies in key links. The support plan has the following four points:

i) Subsidies guide standard operations and form a scalable business operation model. The government should give standardized guidance to the operation of the subsidized enterprises, make explicit provisions on the unimplemented subsidy plan, and restrict the operation behavior of the applicant enterprises. In the short term, government subsidies are used to restrain and regulate the market behavior of highway-railway combined transport enterprises, while projects demonstrating standardized operation are used to guide other enterprises to conduct standard operation in the long term.

ii) To ensure the undertaking the railway plan and the continuity of railway capacity. The government's plan should guide the scientific scheduling of railway freight and the rational planning of new railway special lines, so as to guarantee the railway transport capacity and promote the transfer of medium and long-distance transport to railway.

iii) To clarify the overall planning and layout of logistical hub guidance schemes. The plan needs

to determine the economic circle that the highway-railway combined transport can radiate, and adhere to the principle of optimal layout with the lowest cost and the highest efficiency, that is, the minimum number of layouts at the macro level and full coverage at the micro level.

iv) Multi-channel financial support for multimodal transport enterprises. Due to the huge investment cost in the early stage of intermodal transportation, in addition to government subsidies, state-owned capital, social capital, and other diversified capital should also be encouraged to participate in the demonstrative projects, as well as major projects of highway-railway combined transport. Financial institutions should be encouraged to increase credit support for intermodal enterprises as well.

3.2 Based on the Actual Situation of Intermodal Transportation, Policy Rules Should Promote Convergence

In 2016, the Ministry of Transport issued document GB1589-2016, limiting the highway freight load to 49 tons. On September 21 of the same year, in accordance with unified governance standards of the new regulations (*Administrative Regulations on Overrun Transportation Vehicles on Highways, Special Action Plan for Remediation of Illegal and Overloaded Behaviors of Highway Trucks and Work Plan for Vehicles and Transport Vehicles Management*), provisions controlling large-scale overload, as well as load limits were carried out. Although the one-size-fits-all policy is conducive to regulating the road freight market, it is out of touch with the actual situation of highway-railway combined transport and is difficult to coordinate. The incoordination is mainly manifested in three points: the first is that the weight of the truck and its containers for intermodal transportation usually exceed the limit, which is not conducive to intermodal short-distance transfers. Second, there are many types of non-standard trucks on the market, which not only increase the management difficulty, but also make it difficult to trans-ship goods to railways. Third, highway companies mainly pursue timeliness, but have poor safety, and lack incentives for pursuing cooperation with railways. Taking German policy as an example, there are three main applicable aspects of highway company policy: The first is to broaden the load and time restrictions on highway companies that implement combined transportation. The maximum total weight of trucks can be up to 44 tons in the drayage highway transportation of highway-railway transport (the load limit of ordinary highway trucks is 40 tons), with pickup and delivery restrictions lifted on Sundays and other public holidays (ordinary trucks are restricted). The second is to apply the European Modular Vehicle System (EMS) to promote highly standardized cargo trucks and trailers in highway-railway combined transport. The third is to implement tax reductions and exemptions for short-distance transportation highways. For highway companies with short-distance transportation within 150 kilometers, through policies of corporate income tax reduction and highway use tax exemption, so that these corporations are encouraged to carry out drayage service utilizing highway-railway combined transport.

Starting from the actual situation of highway-railway combined transport, it is necessary to regulate market order and formulate standardized rules. First, relaxing the load limit for trucks that implement highway-railway combined transport. Supplementing the load limit of trucks engaged in drayage business to match the intermodal situation. Second, making clear specifications for the standardization of delivery units, delivery vehicles and equipment. Relevant departments need to guide non-standard vehicles to withdraw from the market, and promote the orderly transfer of medium and long-distance transportation from highways to railways. Third, clarifying the logistical concept of “Safety First”. The rules need to reverse the thinking of the logistical way that time efficiency is greater than safety prevalent among highway companies, and regulate the safety of logistical transportation from the transport supply side. Fourth, using tax incentive policies to incentivize the use of trucks in highway-railway combined transport. The rules need to guide trucks to engage in short-distance road transportation to avoid the impact of the large unemployment rate of truck drivers as much as possible. Fifth, with reference to the European Union Directive 92/106, the rules should be made according to the cohesion standards, service standards, market standards, and information standards focused on by Transportation Standardization Committees to achieve

barrier-free interconnection.

3.3 Facing the Marketization Trend of Intermodal Transportation, the Reform of Operating Entities Should Be Encouraged

Although local railway management bureaus have a discount of no more than 30% within their territorial domain and no more than 50% outside of it, on the basis of the freight guidance price, compared with the flexible highway tariff mechanism, the railway tariff mechanism is out of touch with the market. The first is high through rates, the second is long approval times for preferential tariffs, and the third is the disconnection between the prepayment system and the mainstream post-payment system in the market. Further compared with the international combined transport market, China's highway-railway combined transport market lacks intermodal operators who can lead through all the processes of logistics. Taking the US railway policy for instance, *Staggers Rail Act* issued in 1980 gave railway operators the right to set prices and adjust freight rates independently. Operators and shippers can negotiate the price for different transportation services. Intermodal Surface Transportation Efficiency Act issued in 1990 gradually liberalized transportation market control, guided the development of intermodal transport marketization, and encouraged multiple market entities to participate in intermodal transport.

In the face of the marketization trend of highway-railway combined transport, it is urgent to cultivate participants and start market-oriented reform. There are two ways to achieve this: First, market-oriented reform of railway freight prices. A flexible freight rate mechanism should be developed and diversified services for diversified goods should be provided. In this way, the competitive advantages of highway-railway combined transport can gradually be reflected. At the same time, a certain degree of independent pricing power should be given to railway transportation companies, cumbersome approval procedures should be reduced, and dynamic pricing should be realized in response to market demand. The second is to enrich the main body of highway-railway combined transport business entities. Local government should encourage railway companies, highway companies, freight forwarders, and express companies to transform into highway-railway combined transport operators, and cultivate logistics companies with international competitiveness. At the same time, a credit evaluation system and a reward and punishment mechanism for highway-railway combined transport operations should be established to standardize the compliance operations of multimodal transport operators.

3.4 Focus on Smart Logistics, Support Information Platform Sharing

The Chinese railway information platform 95306 and the highway information platform (such as Truck Gang) are independent. They have not yet been integrated and are in a state of isolation, true islands of information. In addition, it is difficult to share information between highway freight and rail freight. Highway bills and railway bills are highly repetitive. Goods need to be invoiced twice when changing transportation methods. These are obstacles to the realization of full-process logistical information services for highway-railway combined transport. The future developmental direction of logistical information of China is to integrate the intelligent logistics of the Internet of Vehicles, the Internet of Things and the Internet, in order to realize interconnection, deep collaboration and independent decision-making processes. The European highway-railway combined transport has a relatively high degree of informatization. In 2011, the European Union's *Action Plan for Freight Transport and Logistics* proposed the establishment of an open information sharing platform to ensure that railways and highways achieve interaction by building information exchange standards. For example, the information platform established by DB Schenker can realize one-stop freight service for customers, which simplifies complicated formalities and improves operational efficiency.

China's development of highway-railway combined transport should focus on the direction of smart logistics, and build a full process logistical service platform. There are two tasks in terms of informatization. One is to use intermodal big data to build intermodal information platforms and gradually eliminate noninteractive market information. The relevant departments need to create transparent information platforms by integrating highway and railway information, disclosing

carbon emission data and other related operational data, providing real-time quotas and competitive price comparisons, fulfilling online bookings and payment. The second is to simplify procedures and determine an information-sharing mechanism. In the combined transport system, order-changing processes should be reduced, electronic “one order systems” should be developed, in order to create full process online logistics. In addition, a model of cooperation and information alliances should also be promoted. Through information exchange, data sharing, etc., enterprises in different regions and different modes of transportation can form collaborative alliances.

4. Conclusion

As an advanced transportation form that integrates the advantages of high efficiency, safety, economic and environmental protection, highway-railway combined transport achieves improvements in the efficiency of the entire transportation system by giving full play to the respective transportation advantages of railways and highways. As railways are the main force of bulk cargo transportation, the development of highway-railway combined transport can better service the transportation needs of China's energy and industrial structure conditions. At the same time, the applicability of an efficient and convenient highway-railway combined transport mode will be more extensive. The demand for the transport of general merchandise and living goods through railways will further increase in China. Speeding up the promotion of highway-railway combined transport is not only an important means to alleviate air pollution and strengthen environmental protection in the short term, but also could provide a solid guarantee for building a powerful country that uses sustainable transportation and economic development. In a word, it is of great significance to realize green and sustainable development nationally for China.

5. Acknowledgment

Foundation project: The Achievement of “the key special project of advanced rail transit (Number: 2017YFB1201303-03): The key technology of rail transit freight express” of the Ministry of Science and Technology of the People’s Republic of China.

References

- [1] Statistical bulletin on the development of the transportation industry in 2019 [R]. [[online]Available:]http://xxgk.mot.gov.cn/2020/jigou/zhghs/202006/t20200630_3321335.html, 2020-05-12.
- [2] Review of China's road freight industry in 2019 and analysis of the trend of highway freight transportation efficiency and highway logistics freight index in 2020 [EB/OL]. [[online] Available:] <http://www.chyxx.com/industry/202005/859489.html>, 2020-05-07.
- [3] Zhao J, Dong G, Jian W, Zhao Y, Zhang H. Examining the association of economic development with intercity multimodal transport demand in China: A focus on spatial autoregressive analysis. *ISPRS INT J GEO-INF*, 7(2), pp.56, 2018.
- [4] Peng Q. The favorable environment of multimodal transport promotes the in-depth development of transport structure [N]. *Modern Logistics News*, A02, 2019-12-18.